FACULTY OF ENGINEERING
Scheme of Instruction & Examination
(AICTE Model Curriculum)

and

Syllabus
B.E VII and VIII Semesters

of

Four Year Degree Program

in

B.E. Computer Science and Engineering - Data Science
(w.e.f 2023-2024)

Issued by

Dean, Faculty of Engineering
Osmania University, Hyderabad
2023

SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum

B.E.VII - Semester (COMPUTER SCIENCE AND ENGINEERING – DATA SCIENCE)

Proposed for the Academic Year 2023-2024

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC701CD	Big Data Analytics	3	-	-	3	30	70	3	3
2	PC702CD	Deep Learning	3	-	-	3	30	70	3	3
3	PC703CD	Data Handling and Data Visualization	3	-	-	3	30	70	3	3
4	PE-IV	Professional Elective IV	3	-	-	3	30	70	3	3
5	OE-III	Open Elective –II	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	PC751CD	Big Data Analytics Lab	-	-	2	2	25	50	3	1
7	PC752CD	Data Handling and Visualization Lab	-	-	2	2	25	50	3	1
8	PW753CD	Project Work-1	-	-	6	6	50	-	-	3
9	SI754CD	Summer Internship	-	-	-	-	50		-	2
			15	**-**	**10**	**26**	**300**	**450**		**22**

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)
PY: Philosophy, BZ: Biology/ Life Sciences, CE: Civil Engineering, CS: Computer Science and Engineering
EC: Electronics and Communication Engineering, ME: Mechanical Engineering.

Professional Elective IV

Course Code	Course Title
PE741CD	Web and Social Media Analytics
PE742CD	Augmented and Virtual Reality
PE743CD	Block Chain Technology
PE744CD	Image Processing

OPEN ELECTIVE – II	
Course Code	**Course Title**
OE 721CD	Database Management Systems

Big Data Analytics

PC 701 CD

Instruction :	3L per week
Duration of SEE :	3 hours
CIE :	30 marks
SEE :	70 marks

Credits :3

Course Objectives:

Students will try:

- Understand big data for business intelligence.
- Identify business case studies for big data analytics.
- Defend big data Without SQL.
- Discuss the process of data analytics using Hadoop and related tools.

Course Outcomes:

After completing this course the student will able to:

1. Demonstrate big data and use cases from selected business domains.
2. Apply the knowledge of NoSQL big data management and experiment with Install, configure, and run Hadoop and HDFS.
3. Analyze map-reduce analytics using Hadoop.
4. Adapt Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics.

UNIT-I

Understanding Big Data: Characteristics of Data, Introduction to Big Data and its importance, Challenges posed by Big Data, Big data analytics and its classification, Big data applications: big data and healthcare – big data in banking – advertising and big data, big data technologies

UNIT-II

Hadoop Distributed File System: Hadoop Ecosystem, Hadoop Architecture, HDFS Concepts, Blocks, Namenodes and Datanodes, Hadoop FileSystems, The Java Interface, Reading Data from a Hadoop URL, Writing Data, Querying the FileSystem, Deleting Data, Anatomy of File Read and Write

UNIT-III

NOSQL Data Management: Introduction to NOSQL – aggregate data models, aggregates key value and document data models, relationships – graph databases, schema less databases, Sharding - map reduce – partitioning and combining – composing map-reduce calculations.

UNIT-IV

Map Reduce and Yarn: Hadoop Map Reduce paradigm, Map and Reduce tasks, Job and Task trackers, Mapper, Reducer, Map Reduce workflows, classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling – shuffle and sort – task execution – Map Reduce types – input formats – output formats

UNIT-V

Pig: Installing and Running Pig, an Example, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators. Hive: The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User- Defined Functions, writing a User Defined Functions.

Suggested Reading:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilly, 2012, ISBN -13: 978-1449311520, ISBN-10: 1449311520
2. Pramod Sadalage, Martin Fowler, "NoSQL Distilled - A brief guide to the emerging world of polyglot", Addison Wesley 2013
3. Eric Sammer, "Hadoop Operations", O'Reilly, 2012, ISBN -13 978-1449327057, ISBN-10: 1449327052
4. VigneshPrajapati, Big data analytics with R and Hadoop, 2013, ISBN -13: 978-1782163282
5. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly, 2012, ISBN -13: 978-1449319335

Deep Learning

PC 702 CD

Instruction :	3L per week
Duration of SEE :	3 hours
CIE :	30 marks
SEE :	70 marks
Credits :3	

Course Objectives:

- Understand the concept of neural networks, convolutional neural networks, and recurrent neural networks.
- Implement deep learning algorithms, and learn how to train deep networks.
- Gain in-depth knowledge of TensorFlow along with its functions, operations, and the execution pipeline.
- Understanding the major Architectures of Neural Networks and getting into the Convolutional neural Networks.
- Understand the applications of implementing deep learning such as image processing, natural language processing, speech recognition, deep face - facial recognition system, etc.

Course Outcomes:

After completing this course, students will be able to:

1. Understand the fundamentals of deep learning.
2. Understand deep learning algorithms and design neural network.
3. Train and implement a neural network.
4. Gain knowledge about convolutional neural networks.
5. Apply neural networks in various fields.

UNIT – I

What is deep learning? Artificial intelligence, Machine learning, and Deep learning - Artificial intelligence -Machine learning – Learning representations from data - The “deep” in deep learning -Understanding how deep learning works, in three figures -What deep learning has achieved so far.

UNIT – II

Getting started with neural networks - Anatomy of a neural network - Layers: the building blocks of deep learning - Models: networks of layers - Loss functions and optimizers: keysto configuring the learning process.

The Neural Network-Building Intelligent Machines, The Limits of Traditional Computer Programs, The Mechanics of Machine Learning, The Neuron, Expressing Linear Perceptrons as Neurons, Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh

UNIT – III

Training Feed-Forward Neural Networks - The Fast-Food Problem - Gradient Descent - The Delta Rule and Learning Rates - Gradient Descent with Sigmoidal Neurons - The Backpropagation Algorithm- Stochastic and Minibatch Gradient Descent - Test Sets, Validation Sets, and Overfitting- Preventing Overfitting in Deep Neural Networks. Implementing Neural Networks in TensorFlow - What is TensorFlow - Creating and Manipulating TensorFlow Variables - TensorFlow Operations - Placeholder Tensors- Sessions in TensorFlow - Navigating Variable Scopes and Sharing Variables

- Managing Models over the CPU and GPU - Specifying the Logistic Regression Model in TensorFlow - Logging and Training the Logistic Regression Model

UNIT – IV

Introduction to Major Architectures of Deep Networks–Unsupervised Pretrained Networks (UPNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks, Recursive Neural Networks Convolutional Neural Networks -Neurons in Human Vision - The Shortcomings of Feature Selection - Vanilla Deep Neural Networks Don't Scale - Filters and Feature Maps - Full Description of the Convolutional Layer - Max Pooling - Full Architectural Description of Convolution Networks.

UNIT –V

Deep Learning Applications - Large Scale Deep Learning - Computer Vision - Speech Recognition - Natural Language Processing - Other Applications

Suggested Reading:

1. Nikhil Buduma and Nicholas Locascio - Fundamentals of Deep Learning : Designing Next-Generation Machine Intelligence Algorithms – First Edition - O'Reilly , 2017
2. Francois Chollet-Deep Learning with Python-Second Edition, Manning Publications, 2017.
3. Josh Patterson and Adam Gibson- Deep Learning: A Practitioner's Approach - First Edition - O'Reilly , 2017
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville - Deep Learning – Second Edition- MIT Press , 2016

Data Handling and Data Visualization

PC 703 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives:

This course enables the students:

- This course introduces the methods for data preparation and data understanding.
- It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.
- To understand various data visualization techniques.
- Supports to summarize the insurers use of predictive analytics, data science and Data Visualization.

Course Outcomes:

After completing this course, students will be able to:

1. Handle missing data in the real-world data sets by choosing appropriate methods.
2. Summarize the data using basic statistics. Visualize the data using basic graphs and plots.
3. Identify the outliers if any in the data set.
4. Visualize the objects in different dimensions and Design and process the data for Virtualization.
5. Apply the virtualization techniques for research projects.

UNIT-I

Introduction to Exploratory Data Analysis: Data Analytics lifecycle, Exploratory Data Analysis (EDA) – Definition, Motivation, Steps in data exploration, the basic data types Data Type Portability.

UNIT-II

Preprocessing - Traditional Methods and Maximum Likelihood Estimation: Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation – Basics, Missing data handling, improving the accuracy of analysis.

Preprocessing Bayesian Estimation: Introduction to Bayesian Estimation, Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data.

UNIT-III

Introduction and Data Foundation: Basics - Relationship between Visualization and Other Fields - The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets.

Foundations for Visualization: Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables - Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.

UNIT-IV

Visualization Techniques: Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques.

Geospatial Data: Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data- Visualization of Area Data - Other Issues in Geospatial Data Visualization Multivariate Data: Point-Based Techniques - Line- Based Techniques -Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures –Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT-V

Interaction Concepts and Techniques: Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations –Document Collection Visualizations - Extended Text

Visualizations Interaction Concepts: Interaction Operators -Interaction Operands and Spaces - A Unified Framework.

Interaction Techniques: Screen Space -Object-Space -Data Space -Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations -Interaction Control.

Text Books:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt
2. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization
3. Foundations, Techniques, Applications”, 2010.
4. Colin Ware, “Information Visualization Perception for Design”, 2nd edition, Margon Kaufmann Publishers, 2004.

Reference Books:

1. Charu C. Aggarwal, “Data Mining The Text book”, Springer, 2015.
2. Craig K. Enders, “Applied Missing Data Analysis”, The Guilford Press, 2010.
3. Inge Koch, “Analysis of Multivariate and High dimensional data”, Cambridge University Press,2014.
4. Michael Jambu, “Exploratory and multivariate data analysis”, Academic Press Inc., 1990.
5. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC press, 2015
6. Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007.
7. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.

Web & Social Media Analytics

PE 741 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits :3

Course Objectives

The course will introduce the students to

- Exposure to various web and social media analytic techniques.

Course Outcomes

On successful completion of this course, the student should be able to:

1. Gain knowledge on decision support systems.
2. Apply natural language processing concepts on text analytics.
3. Understand sentiment analysis.
4. Apply knowledge on search engine optimization and web analytics.

UNIT-I

An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to Manage a Vaccine Supply Chain Effectively and Safely, Changing Business Environments and Computerized Decision Support, Information Systems Support for Decision Making, The Concept of Decision Support Systems (DSS), Business Analytics Overview, Brief Introduction to Big Data Analytics.

UNIT-II

Text Analytics and Text Mining: Machine Versus Men on Jeopardy!: The Story of Watson, Text Analytics and Text Mining Concepts and Definitions, Natural Language Processing, Text Mining Applications, Text Mining Process, Text Mining Tools.

UNIT-III

Sentiment Analysis: Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Sentiment Analysis and Speech Analytics.

UNIT-IV

Web Analytics, Web Mining: Security First Insurance Deepens Connection with Policyholders, Web Mining Overview, Web Content and Web Structure Mining, Search Engines, Search Engine Optimization, Web Usage Mining (Web Analytics), Web Analytics Maturity Model and Web Analytics Tools.

UNIT-V

Social Analytics and Social Network Analysis: Social Analytics and Social Network Analysis, Social Media Definitions and Concepts, Social Media Analytics. Prescriptive Analytics - Optimization and Multi-Criteria Systems: Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking.

Text Book:

1. Ramesh Sharda, Dursun Delen, Efraim Turban, BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, Pearson Education.

Reference Books:

1. Rajiv Sabherwal, Irma Becerra-Fernandez," Business Intelligence – Practice, Technologies and Management", John Wiley 2011.
2. Lariss T. Moss, ShakuAtre, "Business Intelligence Roadmap", Addison-Wesley It Service.
3. Yuli Vasiliev, "Oracle Business Intelligence: The Condensed Guide to Analysis and Reporting", SPD Shroff, 2012.

Augmented and Virtual Reality

PE 742 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE :	70 marks

Credits :3

Course Objectives

The course will introduce the students to

- To establish and cultivate a broad and comprehensive understanding of AR and VR applications evolving and commercially viable field of Computer Science.

Course Outcomes

On successful completion of this course, the student should be able to:

1. Understand fundamental computer vision, computer graphics and human-computer interaction techniques related to AR/VR.
2. Understand geometric modeling and Virtual environment.
3. Relate and differentiate AR/VR technology.
4. Use various types of Hardware and software in virtual Reality systems
5. Implement Virtual/Augmented Reality applications.

UNIT-I

Introduction to Virtual Reality: Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

UNIT-II

Computer Graphics and Geometric Modeling: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Colour theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms.

Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection.

UNIT-III

Virtual Environment: Input: Tracker, Sensor, Digital Gloves, Movement Capture, Video-based Input, 3D Menus & 3D Scanner etc. Output: Visual /Auditory / Haptic Devices.

Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system.

Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

UNIT-IV

Augmented Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

UNIT-V

Development Tools and Frameworks: Human factors: Introduction, the eye, the ear, the somatic senses. **Hardware:** Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. **Software:** Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

Suggested Readings:

1. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
4. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
5. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.

Block Chain Technology

PE 743 CD

Instruction :	3Lper week
Duration of SEE :	3 hours
CIE :	30 marks
SEE :	70 marks

Credits :3

Course Objectives

- Understand how block chain systems (mainly Bitcoin and Ethereum) work,
- To securely interact with them,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from block chain technology into their own projects.

Course Outcomes:

After completing this course, students will be able to:

1. Understand the design principles of block chain systems - Bitcoin and Ethereum.
2. Understand Distributed Consensus.
3. Design, build, and deploy a distributed application through case study
4. Evaluate security, privacy, and efficiency of a given block chain system.

UNIT - I

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. **Cryptography:** Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

UNIT - II

Blockchain: Introduction, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public block chain.

UNIT - III

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

UNIT - IV

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum -Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

UNIT – V

Cryptocurrency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects- Cryptocurrency Exchange, Black Market and Global Economy.

Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Block chain.

Case study : Naive Blockchain construction, Memory Hard algorithm - Hashcash implementation, Direct Acyclic Graph, Play with Go-ethereum, Smart Contract Construction,Toy application using Blockchain, Mining puzzles

Suggested Readings:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.

2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System

3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger" Yellow paper.2014.

4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

Image Processing

PE 744 CD

Instruction :	3L per week
Duration of SEE :	3 hours
CIE :	30 marks
SEE :	70 marks

Credits :3

Course Objectives

- To introduce basics of visual perception, sampling, quantization and representation of digital images
- To introduce spatial domain and frequency domain filtering techniques necessary for image processing operations.
- To learn advanced image analysis techniques such as image compression, image segmentation, and object recognition
- To learn techniques of colour image processing, multi resolution methods, wavelets and morphological processing

Course Outcomes

After completing this course, the student will be able to:

1. Analyse images in the frequency domain using various transforms
2. Design and implement algorithms that perform image processing operations such as histogram equalization, enhancement, restoration, filtering and denoising
3. Explain colour spaces, restoration and enhancement of colour images
4. Develop simple object recognition systems

UNIT-I

Image Processing: Introduction, Examples, Fundamental steps, Components, Elements of visual perception, Light and Electromagnetic Spectrum, Image sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels.

Intensity Transformations and Spatial Filtering: Background, some basic intensity transformation functions, Histogram processing, Fundamentals of Spatial filtering, smoothing spatial filters, sharpening spatial filters, Combining Spatial Enhancement Methods.

UNIT-II

Filtering in the Frequency Domain: Background, Preliminary concepts, Sampling and Fourier Transform of Sampled Functions, Discrete Fourier Transform (DFT) of one variable, Extension to functions of two variables, Some Properties of the 2-D Discrete Fourier Transform, Basics of Filtering in the Frequency Domain, Image Smoothing, Image Sharpening, Homomorphic Filtering.

Image Restoration: Noise Models, Restoration in the presence of noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering.

Linear Degradation, Position-invariant Degradation, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering, Geometric Mean Filter.

UNIT-III

Colour Image Processing: Colour fundamentals, Colour models, Pseudocolour Image Processing, Basics of Full - colour Image Processing, Colour Transformations, Smoothing and Sharpening, Colour-based Image Segmentation, Noise in Colour Images, Colour Image Compression.

Wavelets and Multi resolution Processing: Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets.

UNIT-IV

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error- free Compression, Lossy Compression, Image Compression Standards, Some Basic Compression Methods. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or- Miss Transformation, Some Basic Morphological Algorithms, Some Basic Gray-Scale Morphological Algorithms.

UNIT-V

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-based Segmentation, Segmentation using Morphological Watersheds, The use of Motion in Segmentation.

Object Recognition: Patterns and Pattern Classes, Recognition based on Decision-theoretic Methods, Structural Methods.

Suggested Readings:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, PHI Learning Pvt. Limited,3rd Edition, 2008.

2. William K. Pratt, Digital Image Processing, John Wiley & Sons, Inc., 3rd Edition, 2001.

Big Data Analytics Lab

PC 752 CD

Instruction :	2 per week
Duration of SEE :	2 hours
CIE :	25 marks
SEE :	50 marks

Credits :1

Course Objectives:

Students will try:

- To provide the knowledge to setup a Hadoop Cluster
- To impart knowledge to develop programs using MapReduce Technique
- To learn file handling in HDFS
- To introduce Pig, PigLatin and HiveQL to process big data
- To learn machine learning operations using Mahout Hadoop
- To introduce NoSQL databases

Course Outcomes:

After completing this course, the student will be able to:

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters
3. Write scripts using Pig to solve real world problems
4. Write queries using Hive to analyse the datasets
5. Apply big data and echo system techniques for real world

List of Experiments to be performed

1. Understanding and using basic HDFS commands
2. Word count application using Mapper Reducer on single node cluster
3. Working with files in Hadoop file system: Reading, Writing and Copying
4. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
5. Retrieving user login credentials from /etc/passwd using Pig Latin
6. Working with HiveQL.
7. Writing User Defined Functions in Hive

Suggested reading:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, April 2015.
2. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.

Data Handling and Visualization Lab

PC 752 CD

Instruction:	2 per week
Duration of SEE:	2 hours
CIE:	25 marks
SEE:	50 marks

Credits :1

Course Objectives:

This course enables the students:

- Understand the various types of data, apply and evaluate the principles of data visualization.
- Acquire skills to apply visualization techniques to a problem and its associated dataset.

Course Outcomes:

After completing this course, the student will be able to:

1. Identify the different data types, visualization types to bring out the insight.
2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on a large dataset.
3. Demonstrate the analysis of a large dataset using various visualization techniques and tools.
4. Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data.
5. Ability to create and interpret plots using R/Python.

List of Experiments:

1. Acquiring and plotting data.
2. Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance.
3. Financial analysis using Clustering, Histogram and HeatMap.
4. Time-series analysis – stock market.
5. Visualization of various massive dataset - Finance - Healthcare - Census – Geospatial.
6. Visualization on Streaming dataset (Stock market dataset, weather forecasting).
7. Market-Basket Data analysis-visualization.
8. Text visualization using web analytics.

Text Books:

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization
2. Foundations, Techniques, Applications”, 2010.
3. Colin Ware, “Information Visualization Perception for Design”, 2nd edition, Margon Kaufmann Publishers, 2004.

Reference Books:

1. Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2 nd Edition, 2007.
2. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.

Project Work -1

PW 753 CD

Instruction:	2 per week
Duration of SEE:	2 hours
CIE:	50 marks
SEE:	

Credits :3

Course Objectives:

- To enhance practical and professional skills
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

After completing this course, the student will be able to:

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:

Collection of project topics/descriptions from faculty members (Problems can also be invited from the industries)

- Grouping of students (max 3 in a group)
- Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices.

This requires students to understand current problems in their domain and methodologies to solve these problems.

To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions.

After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes' presentation followed by 10 minutes' discussion.
3. Submit a technical write-up on the talk.

Atleast two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity)charts
- Presentation- oral and written.

Summer Internship

SI 754 CD

Instruction:	2 per week
Duration of SEE:	2 hours
CIE:	50 marks
SEE:	

Credits: 2

Course Objectives

- To give an experience to the students in solving real life practical problems with all its constraints.
- To give an opportunity to integrate different aspects of learning with reference to real life problems.
- To enhance the confidence of the students while communicating with industry engineers and give an opportunity for useful interaction with them and familiarize with work culture and ethics of the industry.

Course Outcomes

After completing this course, the student will be able to:

1. Able to design/develop a small and simple product in hardware or software.
2. Able to complete the task or realize a pre-specified target, with limited scope, rather than taking up a complex task and leave it.
3. Able to learn to find alternate viable solutions for a given problem and evaluate these alternatives with reference to pre-specified criteria.
4. Able to implement the selected solution and document the same

Summer Internship is introduced as part of the curriculum for encouraging students to work on problems of interest to industries. A batch of two or three students will be attached to a person from an Industry / R & D Organization / National Laboratory for a period of 4 weeks. This will be during the summer vacation following the completion of the VI semester course. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.

After the completion of the internship, students will submit a brief technical report on the internship done and present the work through a seminar talk to be organized by the department. Award of sessional marks are based on the performance of the student at the work place and awarded by industry guide and internal guide (25Marks) followed by presentation before the committee constituted by the department (25Marks).One faculty member will coordinate the overall activity of Summer Internship.

Note:*Students have to undergo summer internship of 4 weeks duration at the end of semester VI and credits will be awarded after evaluation in VII semester.*

Database Management Systems

OE 721 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives

- To Learn mathematical concepts as applied in computer
- To introduce three scheme architecture and DBMS functional components.
- To learn formal and commercial query languages of RDBMS
- To Study different file organization and indexing techniques
- To familiarize theory of serializablity and implementation of concurrency control, and recovery

Course Outcomes

After completing this course, the student will be able to:

1. Understand the mathematical foundations on which RDBMS are built
2. Model a set of requirements using the Extended Entity Relationship Model (EER), transform an EER model into a relational model and refine the relational model using theory of normalization
3. Develop Database application using SQL and Embedded SQL
4. Use the knowledge of file organization and indexing to improve database application performance
5. Understand the working of concurrency control and recovery mechanisms in RDBMS

UNIT-I

Introduction: Database System Application, Purpose of Database Systems, View of Values, Nested Sub- queries, Complex Queries views, Modification of the Databaae, Joined Relations
Data, Database Language, Relational Databases, Database Design, Object-Based and Semi-Structured Databases, Data Storages and Querying , Transaction Management ,Data Mining and Analysis, Database Architecture, Database Users and Administrators.

U**NIT-II**

Database Design and the E-R Model: Overview of the Design Process, The Entity Relationship Model Constraints, Entity-Relationship Design issues, Weak Entity Sets Extended E-R Features Database Design for banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design.

UNIT-III

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Null Values, Modification of the Databases
Structured Query Language: Data Definition, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null

UNIT-IV

Relational Database Design: Features of Good Relational Design, Atomic Domains and First Normal Form, Functional Dependency Theory, Decomposition using Functional Dependencies.
Indexing and Hashing: Basic Concepts, Ordered Indices, B*-tree index files, B-tree index files,

multiple key access, static hashing, dynamic hashing, comparison of ordered indexing and hashing bitmap indices.

UNIT-V

Concurrency Control: Lock based protocols, timestamp based protocols, validation based protocols, multiple granularity, multi version schemes, deadlock handling.

Recovery system: Failure classification, storage structure, recovery and atomicity, log-based recovery, recovery with concurrent transactions, buffer management, remote backup systems.

Suggested Readings:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGraw-Hill, 6th Edition, 2010
2. Ramakrishnan, Gehrke, Database Management Systems, McGraw-Hill, 3rd Edition, 2003
3. Elmasri, Navathe, Somayajulu, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2004.

SCHEME OF INSTRUCTION & EXAMINATION
AICTE Model Curriculum
B.E.VIII - Semester (COMPUTER SCIENCE AND ENGINEERING – DATA SCIENCE)
Proposed for the Academic Year 2022-2023

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PE-V	Professional Elective V	3	-	-	3	30	70	3	3
2	OE-III	Open Elective-III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
3	PW801CD	Project Work – II	-	-	16	16	50	100	3	8
			6	**-**	**16**		**110**	**240**		**14**

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam)
PO: Political Science, EG: English, CM: Commerce, MT: Mathematics,
CS: Computer Science and Engineering, EC: Electronics and Communication Engineering,

Course Code	Course Title
PE851CD	Information Theory and Coding
PE853CD	Human Computer Interaction
PE855CD	Natural Language Processing
PE856CD	Intellectual Property Rights

OPEN ELECTIVE-III	
Course Code	**Course Title**
OE831CD	Cognitive Science and Analytics

Information Theory and Coding

PE 851 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives:

- Understand the Concept Of Entropy, Rate of information and order of the source with reference to dependent and independent source.
- Study various source encoding algorithm
- Model discrete & continuous communication channels.
- Study various error control coding algorithm

Course Outcomes:

After completing this course, the student will be able to:

1. Explain concept of dependent & independent source, measure of information, Entropy, Rate of information and order of a source
2. Represent the information using Shannon encoding, Shannon fano, prefix and Huffman encoding algorithms
3. Model the continues and discrete communication channels using input, output and joint probabilities
4. Determine a codeword comprising of the check bits computed using linear block codes, cyclic code & convolutional codes
5. Design the encoding and decoding circuits for linear block codes, cyclic codes, convolutional codes, BCH and Golay codes

UNIT-I

Information Theory: Introduction, measure of information, information content of message, average information content of symbols in long independent sequences, average information content of symbols in long dependent sequences**,** Markov statistical model for information sources, entropy and information rate of MArkoff Sources.

UNIT-II

Source Coding: Encoding of the source output, Shannon's encoding algorithm, Shannon fano encoding algorithm, source coding theorem, Prefix codes, Kraft McMillan Inequality property-KMI, and Huffman codes.

UNIT-III

Information Channels: Communication channels, discrete communication channels channel matrix. Joint probability matrix, binary symmetric channel, system entropic.

Mutual information, channel capacity, channel capacity of binary symmetric channel, binary erasure channel, Muroga's theorem.

UNIT-IV

Error Controlling code: Introduction, Examples of error control coding, methods of controlling errors, types of errors, type of codes, linear block codes: matrix description of linear block code, error detection & correction capabilities of linear block codes, single error correction hamming code, table lookup decoding using standard array,

Binary cyclic codes: Algebraic structure of cyclic codes, encoding using an (n-k) bit shift register, syndrome calculation, error detection and correction.

UNIT-V

Convolution codes: Convolution encoder, time domain approach transform domain approach, code tree, trellis and state diagram, the Viterbi algorithm

Text Book:

1. Digital and analog communication systems, K.Sam Shanmugam, John Wiley India Pvt.Ltd,1996
2. Digital communication, Simon Haykin, John Wiley India Pvt.Ltd,2008

Human Computer Interaction

PE 852 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives:

- To introduce interaction frameworks and styles
- To learn about interaction design process, design standards and principles
- To introduce the concept of usability and usability testing
- To familiarize interface components and technical issues of concern
-

Course Outcomes:

After completing this course, the student will be able to:

1. Specify, design and implement a prototype that involves significant human computer interaction.
2. Describe typical human–computer interaction (HCI) models and styles, as well as various historic HCI paradigms.
3. Understand that the interfaces' design emerges iteratively, through repeated design–evaluation–redesign cycles involving users.
4. Characterize the user experience in terms of usability, user experience goals, and design principles.
5. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

UNIT- I

Interaction Paradigms: Computing Environments, Analyzing Interaction Paradigms
Interaction Frameworks and Styles: Frameworks for Understanding Interaction, Coping with Complexity, Interaction Styles.

UNIT- II

Interaction Design Process: Iterative Design, User-Centered Design, Interaction Design Models, Overview of Interaction Design Models
Discovery: Discovery Phase Framework, Collection, Interpretation, Documentation
Design: Conceptual Design, Physical Design, Evaluation, Interface Design Standards, Designing the Facets of the Interface

UNIT- III

Design Principles: Principles of Interaction Design, Comprehensibility, Learnability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, Stimulus Intensity, Proportion, Screen Complexity, Resolution/Closure, and Usability Goals
Interaction Design Models: Model Human Processor, Keyboard Level Model, GOMS, Modeling Structure, Modeling Dynamics, Physical Models
Usability Testing: Usability, Usability Test, Design the Test, Prepare for the Test, Perform the Test, Process the Data

UNIT- IV

Interface Components: The WIMP Interface, Other Components

Icons: Human Issues Concerning Icons, Using Icons in Interaction Design, Technical Issues Concerning Icons

Color: The Human Perceptual System, Using Color in Interaction Design, Color Concerns for Interaction Design, Technical Issues Concerning Color

UNIT- V

Text: Human Issues Concerning Text, Using Text in Interaction Design, Technical Issues **Concerning Text Speech and Hearing :** The Human Perceptual System, Using Sound in Interaction Design, Technical Issues Concerning Sound Touch and Movement: The Human Perceptual System, Using Hap-tics in Interaction Design, Technical Issues Concerning Hap-tics

Suggested reading:

1. Steven Heim, The Resonant Interface: HCI Foundations for Interaction Design, Addison-Wesley, 2007
2. J. Preece, Y. Rogers, and H. Sharp, Interaction Design: Beyond Human-Computer Interaction, Wiley & Sons,2nd Ed., 2007
3. Ben Shneiderman, Catherine Plaisant, Designing the User Interface: Strategies for Effective Human-Computer Interaction, 5th edition,, Addison-Wesley, 2009

Natural Language Processing

PE 853 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks
Credits: 3	

Course Objectives

- Teach students the leading trends and systems in natural language processing.
- Make them understand the concepts of morphology, syntax and semantics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.
- Teach them to recognize the significance of pragmatics for natural language understanding.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic and semantic processing.

Course Outcomes

After completing this course, the student will be able to:

1. Tag a given text with basic Language features
2. Design an innovative application using NLP components
3. Implement a rule based system to tackle morphology/syntax of a language
4. Design a tag set to be used for statistical processing for real-time applications
5. Compare and contrast the use of different statistical approaches for different types of NLP applications.
6. Perform various language phonetic analysis

UNIT I

Introduction of NLP: Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Automata, Morphology and Finite State Transducers, Tokenization, stemming, Normalization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II

WORD LEVEL ANALYSIS: N-grams, Evaluating N-grams, Smoothing, Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Entropy, Hidden Markov and Maximum Entropy models, ; Named Entities

UNIT-III

SYNTACTIC ANALYSIS: Context free rules and trees – The noun Phrase – Co-ordination – Verb phrase – context free grammars – Parsing with context free grammars, Shallow parsing – Probabilistic CFG, Dependency Grammar, Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.

UNIT_IV

Speech Fundamentals: Phonetics – speech sounds and phonetic transcription –articulatory phonetics – phonological categories and pronunciation variation– acoustic phonetics and signals – phonetic resources – articulatory and gestural phonology.

UNIT-V

Speech synthesis – text normalization – phonetic analysis – prosodic analysis – diphone waveform synthesis – unit selection waveform synthesis – evaluation.

Text Books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to NaturalLanguage Processing, Computational Linguistics andSpeech, Pearson Publication, 2014.

2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processingwith Python, FirstEdition, OReilly Media, 2009.

References:

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher,2015.

2. Richard M Reese, —Natural Language Processing with Java, OReilly Media, 2015.

3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press,2010.

4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

5. Ikrami Eldirawy , Wesam Ashour, —Visual Speech Recognition, Wiley publications,2011

6. Himanshu Chaurasiya, —Soft Computing Implementation of Automatic Speech Recognition,LAP Lambert Academic Publishing,2010.

7. Kai-Fu Lee, —Automatic Speech Recognition, The Springer International Series in Engineering and Computer Science, 1999.

Intellectual Property Rights

PE 854 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives:

- The knowledge on world trade organization, trade agreements and investments.
- The importance of intellectual property rights to develop trade mark law, copy right law and patent law.
- The new developments in the law of intellectual property rights in order to bring progressive changes towards a free market society and international trade practices under the trade related Intellectual Property Rights Agreement (TRIPS).

Course Outcomes

By the end of this course, the students will be able to

1. Classify the intellectual property rights to provide the legal rights, patents, trademarks, copyrights and trade secrets.
2. Relate the World Intellectual Property organization to protect intellectual property rules and policies.
3. Identify the world trade organization agreements for trade related intellectual properties rights and investments.
4. Outline the importance of intellectual property in organizations of different industrial sectors for the purpose of product and technology development.
5. Infer the geographical Indications of international development of law for policy and legal issues.
6. Interpret the purpose in category of marks for the international trademark registration.
7. Extend the fundamentals of copyright law and originality of material for the rights of reproduction.
8. Demonstrate the international copyright law with respect to ownership for the registration of copyright.
9. Summarize the trade secrets determination, misappropriation and protection for submission and litigation.
10. Utilize the new international developments for trademarks law, copyright law and patent law.

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international Organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, Selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for mis-appropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Suggested Readings:

1. Deborah. E. Bouchoux, Intellectual property right, Cengage learning.
2. Prabuddha ganguli, Intellectual property right – Unleashing the knowledge economy Tata McGraw Hill Publishing company ltd

Project Work - II

PW 801 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives

- To enhance practical and professional skills
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

By the end of this course, the students will be able to

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project work –II is to implement and evaluate the proposal made as part of Project Work - I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for 25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

Cognitive Science and Analytics

OE 831 CD

Instruction:	3L per week
Duration of SEE:	3 hours
CIE:	30 marks
SEE:	70 marks

Credits: 3

Course Objectives:

- To study the basic concepts and approaches in the field of cognitive science
- To apply the concepts of planning, reasoning and learning models in cognitive applications
- To analyze language and semantic models of cognitive process

Course Outcomes:

After completing this course, the student will be able to:

1. Understand the basic concept of cognitive science
2. Understand the learning model and apply the same to appropriate real world applications
3. Apply reasoning methodology to real world applications
4. Understand and apply declarative and logic models
5. Envisage the concept of cognitive learning
6. Acquire knowledge in language processing and understanding

UNIT I: **Introduction to Cognitive Science**

Fundamental Concepts of cognitive science – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science – Artificial Intelligence: Knowledge representation, semantic networks, frames, conceptual dependency, scripts.

UNIT II: **Planning and Learning Methods**

Planning – Situation Logic- Learning in Cognitive Systems- Rote Learning – Learning by Examples - Incremental Concept Learning – Inductive Learning - Classification Techniques – Statistical Reasoning.

UNIT III: **Reasoning methods**

Reasoning by analogy – Explanation based reasoning – Case based reasoning- Constraint Satisfaction- Constraint Propagation- Temporal reasoning – Temporal Constraint Networks- Spatial reasoning- Visual Spatial reasoning- Meta reasoning – Learning by correcting mistakes-AI ethics

UNIT IV: Cognitive Modeling

Declarative/ logic-based computational cognitive modelling - connectionist models of cognition – Bayesian models of cognition - Cognitive Models of Memory and Language - Computational models of episodic and semantic memory - modelling psycholinguistics (with emphasis on lexical semantics).

UNIT V: Modeling Paradigm

Modelling Select Aspects of Cognition Classical models of rationality - symbolic reasoning and decision making under uncertainty - Formal models of inductive generalization causality - Categorization and similarity analysis.

Text Book(s)

1. José Luis Bermúdez, “Cognitive Science: An Introduction to the Science of the Mind”, Cambridge University Press, New York, 2014.
2. Mallick, Pradeep Kumar, Borah, Samarjeet," Emerging Trends and Applications in Cognitive Computing”, IGI Global Publishers, 2019.
3. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill Education, 2012.

Reference Books

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, Third Edition, Pearson Publishers, 2015.
2. Paul Miller, “An Introductory Course in Computational Neuroscience”, MIT Press, 2018.
3. Jerome R. Busemeyer, Zheng Wang, James T. Townsend, Ami Eiders(Ed), “The Oxford Handbook of Computational and Mathematical Psychology”, Oxford University Press (2015).
4. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, “Cognitive Science: An Introduction”, Second Edition, MIT press, 1995.